



Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Imperial Ponds Conservation Area

2017 Annual Report



October 2018

Work conducted under LCR MSCP Work Task E14

Lower Colorado River Multi-Species Conservation Program Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState Local Governments Authority
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Wildlife
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

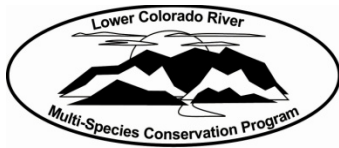
Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
Chemehuevi Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.
The Nature Conservancy



Lower Colorado River Multi-Species Conservation Program

Imperial Ponds Conservation Area

2017 Annual Report

Prepared by:

Andrea Finnegan, Restoration Group

Chris Dodge, Wildlife Group

Jeff Lantow, Fisheries Group

Becky Blasius, Adaptive Management Group

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
<http://www.lcrmscp.gov>

October 2018

Finnegan, A., C. Dodge, J. Lantow, and B. Blasius. 2018. Imperial Ponds Conservation Area, 2017 Annual Report. Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada.

ACRONYMS AND ABBREVIATIONS

DO	dissolved oxygen
FY	fiscal year
Imperial NWR	Imperial National Wildlife Refuge
IPCA	Imperial Ponds Conservation Area
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
lidar	light detection and ranging
mg/L	milligrams per liter
pH	the acidity or basicity (alkalinity) of an aqueous solution
PIT	passive integrated transponder
Reclamation	Bureau of Reclamation
USFWS	U. S. Fish and Wildlife Service

Symbols

°C	degrees Celsius
>	greater than
<	less than
μS/cm	microsiemens per centimeter
%	percent

CONTENTS

	Page
1.0 Introduction.....	1
1.1 Background.....	1
2.0 Conservation Area Site Information	1
2.1 Purpose.....	1
2.2 Location	1
2.3 Landownership.....	3
2.4 Water.....	3
2.5 Agreements	3
2.6 Public Use	3
2.7 Law Enforcement.....	3
2.8 Wildfire Management	4
3.0 Habitat Development and Management.....	4
3.1 Planting	4
3.2 Irrigation	4
3.3 Site Management	7
3.4 Management of Existing Land Covers and Habitat.....	7
3.4.1 Pond Management	7
3.4.2 Field Management	7
4.0 Monitoring	7
4.1 Backwater Monitoring	7
4.1.1 Native Fishes.....	7
4.1.2 Water Quality Monitoring.....	12
4.2 Avian Monitoring.....	13
4.2.1 Marsh Bird Surveys	15
5.0 Habitat Creation and Conservation Measure Accomplishment.....	15
5.1 Vegetation Monitoring.....	15
5.2 Evaluation of Conservation Area Habitat	16
6.0 Adaptive Management	16
Literature Cited	19

Tables

Table	Page
1 Target water delivery schedule for the IPCA ponds	6
2 Water usage summary for 2017	6
3 FY17 Imperial Ponds native fish stockings	8
4 FY17 Imperial Ponds monitoring effort	12
5 FY17 Imperial Ponds monitoring results.....	12
6 Species-specific habitat creation conservation measure creditable total acres for 2017.....	16

Figures

Figure	Page
1 Location of the IPCA.	2
2 IPCA managed acreage.....	5
3 Pond 1 razorback sucker population, FY17.....	9
4 Pond 3 razorback sucker population, FY17.....	9
5 Pond 4 razorback sucker population, FY17.....	10
6 Pond 2 bonytail population, FY17.....	10
7 Pond 5 bonytail population, FY17.....	11
8 Pond 6 bonytail population, FY17.....	11
9 Imperial Ponds 1–6 water temperature, FY17.....	13
10 Imperial Ponds 1–6 DO, FY17.....	14
11 Imperial Ponds 1–6 pH, FY17.....	14
12 Imperial Ponds 1–6 specific conductivity, FY17.....	15

1.0 INTRODUCTION

The purpose of this annual report is to summarize all activities that have occurred at the Imperial Ponds Conservation Areas (IPCA) from October 1, 2016, through September 30, 2017, which is Federal fiscal year (FY) 2017. Water usage is presented as a calendar year, January 1 through December 31, 2017, consistent with the Colorado River Accounting and Water Use Report: Arizona, California, and Nevada, Calendar Year 2017 (Bureau of Reclamation [Reclamation] 2018).

1.1 Background

In 2005, Reclamation partnered with the U. S. Fish and Wildlife Service (USFWS) to fulfill a portion of the Lower Colorado River Multi-Species Conservation Program's (LCR MSCP) habitat creation/restoration goals. A Land Use Agreement has been entered into between Reclamation and the USFWS that identifies 126 acres of program lands that comprise the IPCA and secures water for the Imperial National Wildlife Refuge (Imperial NWR).

2.0 CONSERVATION AREA SITE INFORMATION

2.1 Purpose

The IPCA was developed for both native fishes and terrestrial wildlife species. Currently, the IPCA consists of six disconnected backwaters totaling 80 acres created as backwater habitat for razorback suckers (*Xyrauchen texanus*) and bonytail (*Gila elegans*). There are 12 acres of managed marsh for California black rails (*Laterallus jamaicensis coturniculus*), Yuma clapper rails (*Rallus longirostris yumanensis* [also known as Yuma Ridgway's rail = *R. obsoletus yumanensis*]), and western least bitterns (*Ixobrychus exilis hesperis*). Thirty-four acres will be developed as riparian habitat for southwestern willow flycatchers (*Empidonax traillii extimus*), yellow-billed cuckoos (*Coccyzus americanus occidentalis*), and other LCR MSCP species as identified in the LCR MSCP Habitat Conservation Plan (LCR MSCP 2004).

2.2 Location

The IPCA is located within Reach 5 of the LCR MSCP program area (figure 1). It consists of 126 acres of land on the Imperial NWR, located in Arizona, at River Mile 59.

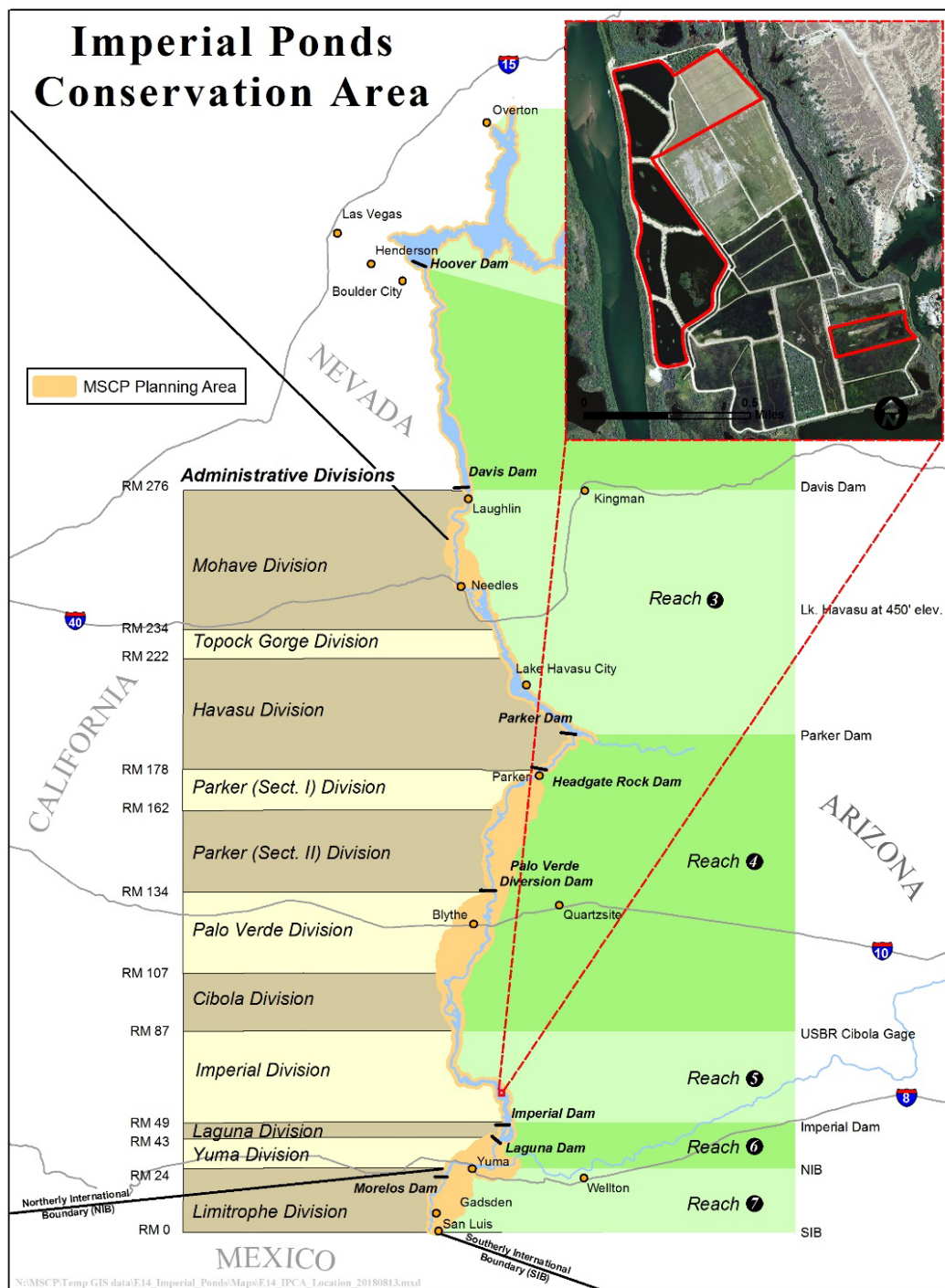


Figure 1.—Location of the IPCA.

2.3 Landownership

The IPCA is located on the Imperial NWR, which is owned and managed by the USFWS.

2.4 Water

The IPCA receives water from the Imperial NWR's entitlement granted by the 1964 Supreme Court Decree in *Arizona v. California* and by U.S. Department of the Interior Secretarial reservation. The Imperial NWR has an entitlement of 28,000 acre-feet of water diverted from the main stream, or 23,000 acre-feet of consumptive use of main stream water, whichever is less, with a priority date of February 14, 1941. The water used for the ponds and irrigation is supplied from a portion of this water.

2.5 Agreements

A Land Use Agreement was signed in 2006 by Reclamation and the USFWS to secure land and water for the IPCA for the remainder of the 50-year LCR MSCP. The agreement outlines the rights and responsibilities of each partner in the project's development and maintenance.

2.6 Public Use

The IPCA is in an area that was closed to the public by the USFWS prior to becoming a conservation area; it remains closed to the public.

2.7 Law Enforcement

Law enforcement activities are performed primarily by the USFWS's Law Enforcement Officer, under the LCR MSCP's site-specific Fire Management & Law Enforcement Strategy (LCR MSCP 2010). Additional local law enforcement assistance is available through the Arizona Game and Fish Department's Yuma Office, the Yuma County Sheriff's Office, and the Bureau of Land Management's Yuma Office.

2.8 Wildfire Management

The USFWS will provide an appropriate management response to all wildfires that occur within the IPCA. The full range of suppression strategies is available to managers provided that selected options do not compromise firefighter or public safety, are cost effective, consider the benefits of suppression and the values to be protected, and are consistent with resource objectives (LCR MSCP 2010).

3.0 HABITAT DEVELOPMENT AND MANAGEMENT

Three distinct land cover types are being created at the IPCA. The first is a series of disconnected backwaters, managed for native fishes, which have been constructed. The second is a small marsh complex, managed for rail species, which is also operational. The third is a stand of Fremont cottonwood-Goodding's willow (*Populus fremontii*-*Salix gooddingii*) (hereafter cottonwood-willow), which has not yet been planted. The managed acreage is shown on figure 2.

3.1 Planting

No planting occurred at the IPCA during FY17. Future development of 34 acres of cottonwood-willow fields is currently on hold until canal upgrades are completed.

3.2 Irrigation

Two groundwater wells supply water to all six ponds being managed for native fishes. Each pond receives approximately 8.5 acre-feet of water per month, except during July through September, when the water volume increases to 17 acre-feet of water per month, for a total of 771 acre-feet of water for the year (table 1).

Water delivery during 2017 is shown in table 2. The ponds received 793 acre-feet of water. Irrigation to the cottonwood-willow fields and marsh Field 18 began in mid-February 2017 and continued through September 2017. The system has only one flow meter for the entire complex, so irrigation to the cottonwood-willow fields and Field 18 must be estimated. The amount of water used in the cottonwood-willow fields and marsh Field 18 is estimated based on the assumption that the cottonwood-willow fields will use 20% of the total water delivered to the farming complex and marsh Unit18 will use 8%.

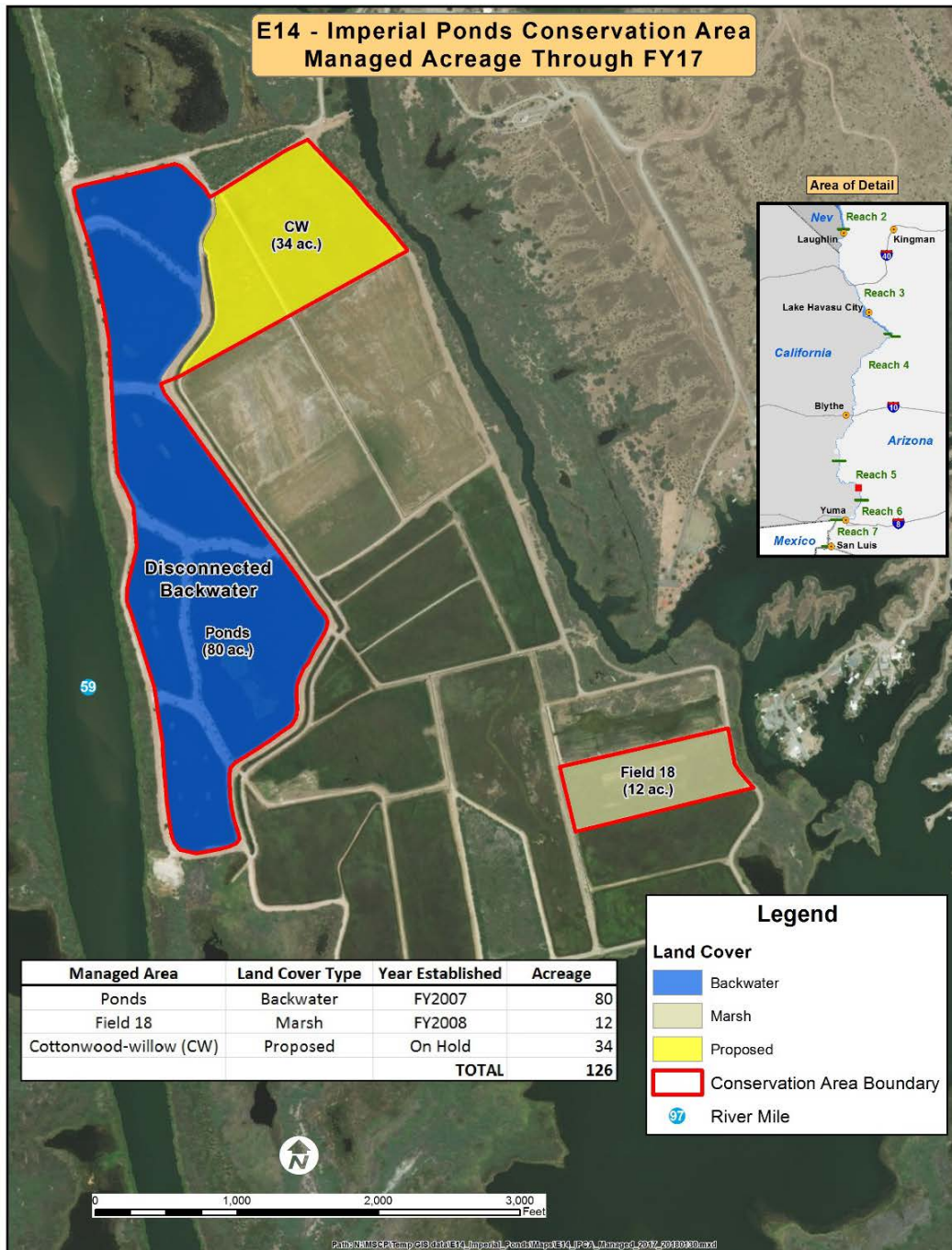


Figure 2.—IPCA managed acreage.

**Imperial Ponds Conservation Area
2017 Annual Report**

Table 1.—Target water delivery schedule for the IPCA ponds

Month	Monthly target volume per pond (gallons)	Total monthly target (gallons)	Total monthly target (acre-feet)	Operation cycle	Pond(s)	Weekly operation hours
January February March	2,800,000	16,800,000	51.41	Week 1	1, 2, 3	45
				Week 2	4, 5, 6	
				Week 3	1, 2, 3	
				Week 4	4, 5, 6	
April May June	2,800,000	16,800,000	51.41	Week 1	1, 2, 3	45
				Week 2	4, 5, 6	
				Week 3	1, 2, 3	
				Week 4	4, 5, 6	
July August September	5,600,000	33,600,000		Week 1	1, 2, 3	90
				Week 2	4, 5, 6	
				Week 3	1, 2, 3	
				Week 4	4, 5, 6	
October November December	2,800,000	16,800,000	51.41	Week 1	1, 2, 3	45
				Week 2	4, 5, 6	
				Week 3	1, 2, 3	
				Week 4	4, 5, 6	
Total annual delivery for all six ponds per year (acre-feet)						771

Table 2.—Water usage summary for 2017

Location	Annual water usage (acre-feet)	Annual water usage by habitat type (acre-feet)
Pond 1	115	793
Pond 2	165	
Pond 3	126	
Pond 4	117	
Pond 5	137	
Pond 6	133	
Cottonwood-willow Field 1	84	134
Cottonwood-willow Field 2	50	
Marsh Field18	150	150

3.3 Site Management

The Imperial NWR mowed and trimmed vegetation around the ponds to keep boat access open and rights-of-way clear.

3.4 Management of Existing Land Covers and Habitat

3.4.1 Pond Management

Operation and management of the IPCA primarily relates to the control, manipulation, and management of water to the backwaters, marsh, and riparian fields. This includes pumping water into the marsh or riparian fields and operating gates and other control infrastructure to manage delivery of water into the IPCA. Water management may be adjusted seasonally to accommodate evapotranspiration rates and wildlife habitat requirements.

3.4.2 Field Management

Irrigation of Fields 1 and 2, scheduled for cottonwood-willow planting, continued in an effort to reduce soil salinity until planting. Irrigation of Field 18, which is managed as a marsh, continued.

4.0 MONITORING

Many of the monitoring activities are part of larger monitoring projects for the LCR MSCP. Additional information is available in the technical reports on the LCR MSCP Web site (www.lcrmscp.gov) or upon request.

4.1 Backwater Monitoring

Native fish monitoring resumed in all six ponds at the IPCA in FY17. Native fishes have been absent from these ponds since renovation efforts were completed in FY15. Pond water quality was also monitored throughout the year at a similar level as previously reported.

4.1.1 Native Fishes

Native fishes were stocked into all six ponds during FY17. Ponds 1, 3, and 4 were stocked with razorback suckers in December 2016, and Ponds 2, 5, and 6 were stocked with bonytail in March 2017. Each pond was stocked with

**Imperial Ponds Conservation Area
2017 Annual Report**

approximately 300 adult fish in an even ratio of males to females (table 3). A tissue sample was collected from each fish to facilitate genetic monitoring being conducted under Work Task C40. Fishes were released in advance of their known spawning season, January – April for razorback suckers and April – May for bonytail, to allow for reproduction in the ponds. All fishes were injected with passive integrated transponder (PIT) tags prior to release.

Table 3.—FY17 Imperial Ponds native fish stockings
(Pond, total of each species stocked, sex ratios, and average total length at stocking)

Pond	Razorback suckers (male/female)	Average length at stocking (mm)	Bonytail (male/female)	Average length at stocking (mm)
1	300 (150/150)	430		
2			299 (150/149)	272
3	300 (150/150)	426		
4	300 (150/150)	436		
5			300 (150/150)	272
6			300 (150/150)	271

Fish monitoring at the Imperial Ponds was focused on monitoring the adult populations via remote PIT tag scanners and documenting spawning/recruitment within the ponds through larval fish surveys and minnow trapping.

Remote PIT tag scanning was accomplished using a combination of mobile and permanent scanners. Mobile PIT tag scanners were used to supplement permanent scanners while installation and trouble shooting was being completed. Mobile scanners also served to locate scanning “hot spots” within the ponds to help determine the best placement for permanent scanners. Upon completion, each pond was outfitted with two to three permanent scanners, which were set to run continuously. In an effort to maximize scanning contacts, weirs were attached to one antenna in Ponds 4, 5, and 6. Data were downloaded approximately every 2 weeks during each site visit.

Remote PIT tag scanning contacts were used to track razorback populations from December 2016 through September 2017. Population estimates were calculated every 2 weeks. The population estimates as of September 2017 were: Pond 1 – 199 fish, Pond 3 – 185 fish, and Pond 4 – 224 fish (figures 3–5). These population estimates represent 66, 62, and 75% survival, respectively, at 9 months post-release.

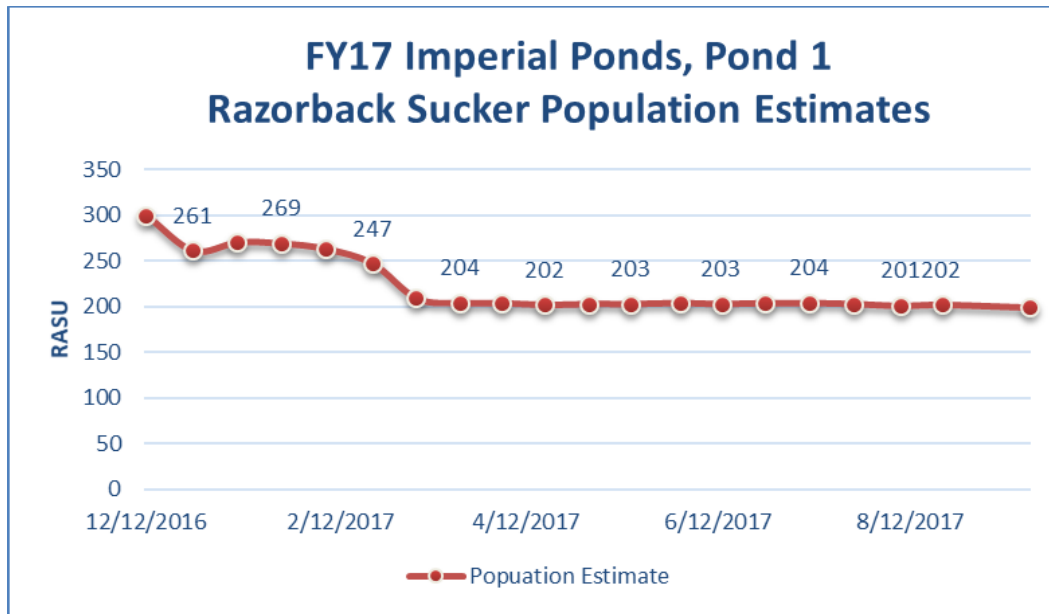


Figure 3.—Pond 1 razorback sucker population, FY17.

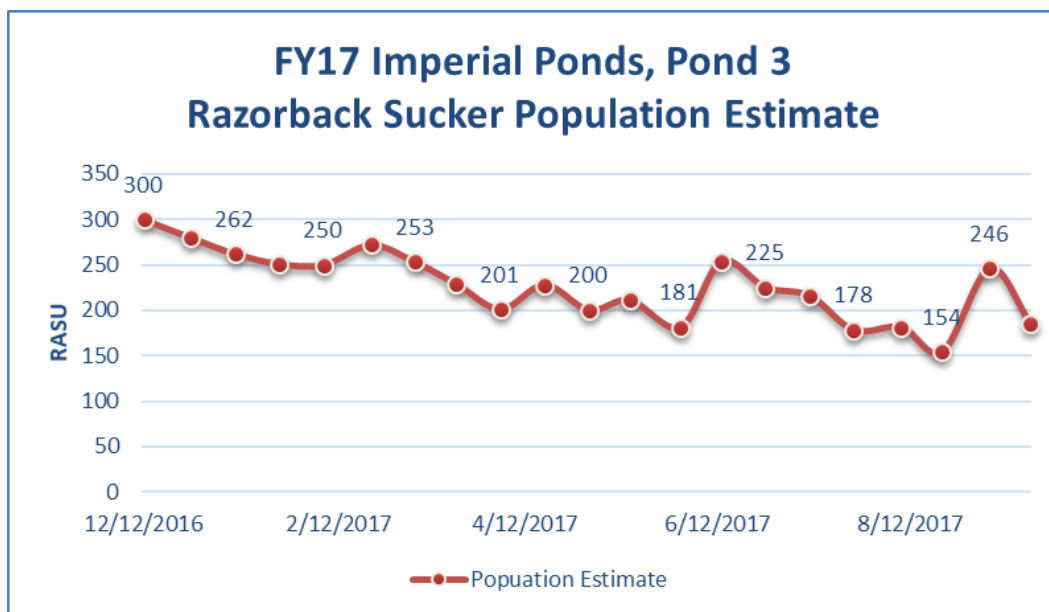


Figure 4.—Pond 3 razorback sucker population, FY17.

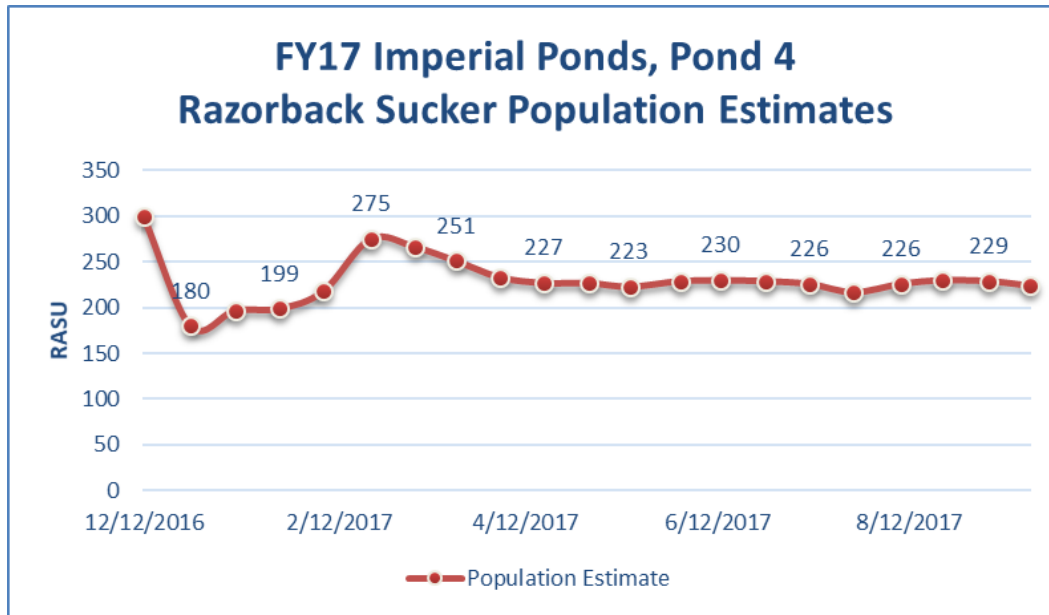


Figure 5.—Pond 4 razorback sucker population, FY17.

Similar to the razorback sucker ponds, remote PIT tag scanning contacts were used to track bonytail populations from the time they were stocked: March through September 2017. Population estimates were calculated every 2 weeks. The population estimates as of September 2017 were: Pond 2 – 142 fish, Pond 5 – 273 fish, and Pond 6 – 219 fish (figures 6–8). These population estimates represent 47, 91, and 73% survival, respectively, at 6 months post-release.

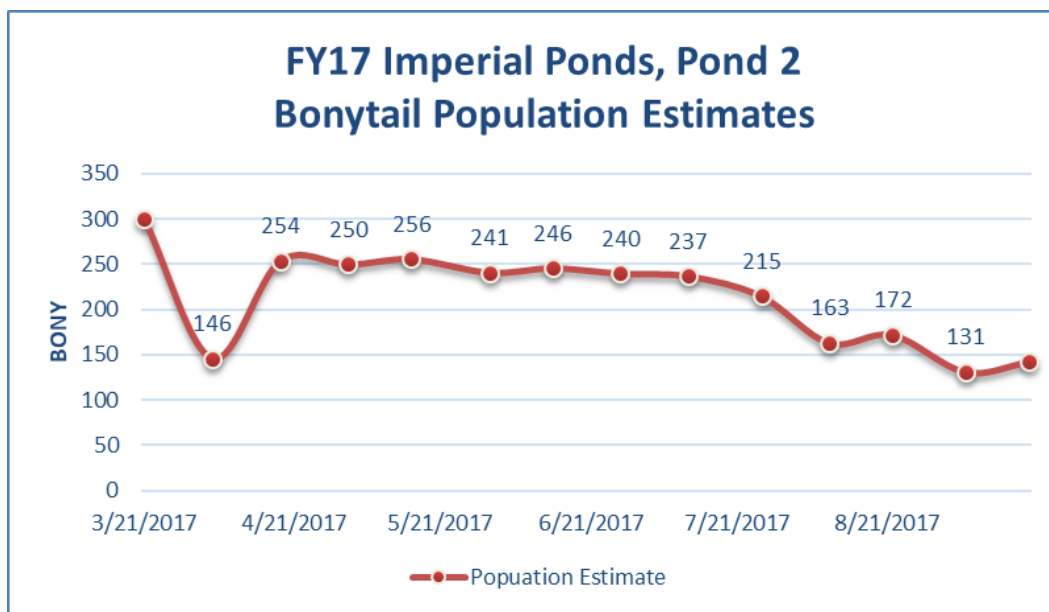


Figure 6.—Pond 2 bonytail population, FY17.

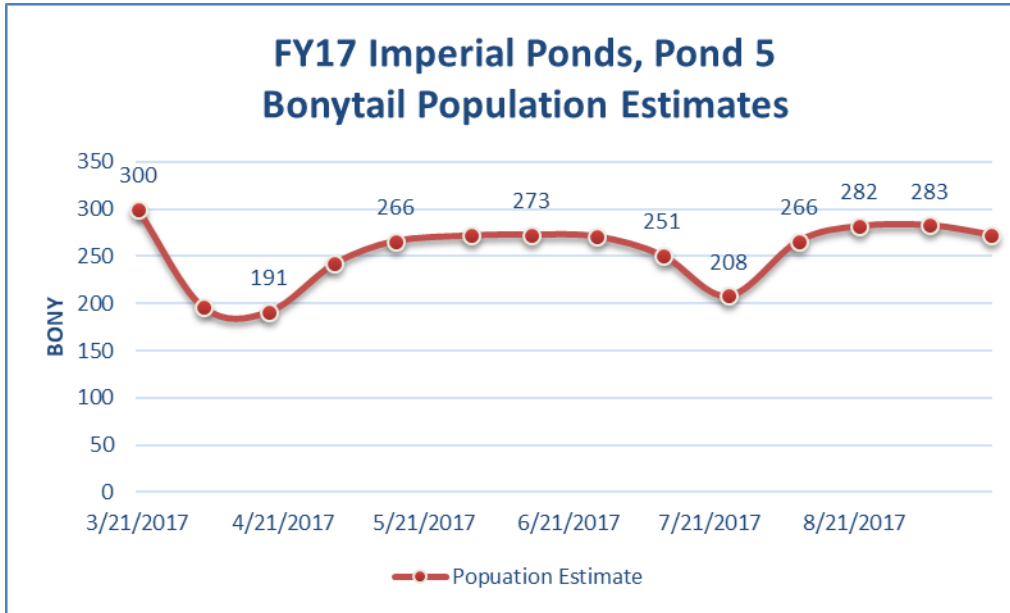


Figure 7.—Pond 5 bonytail population, FY17.

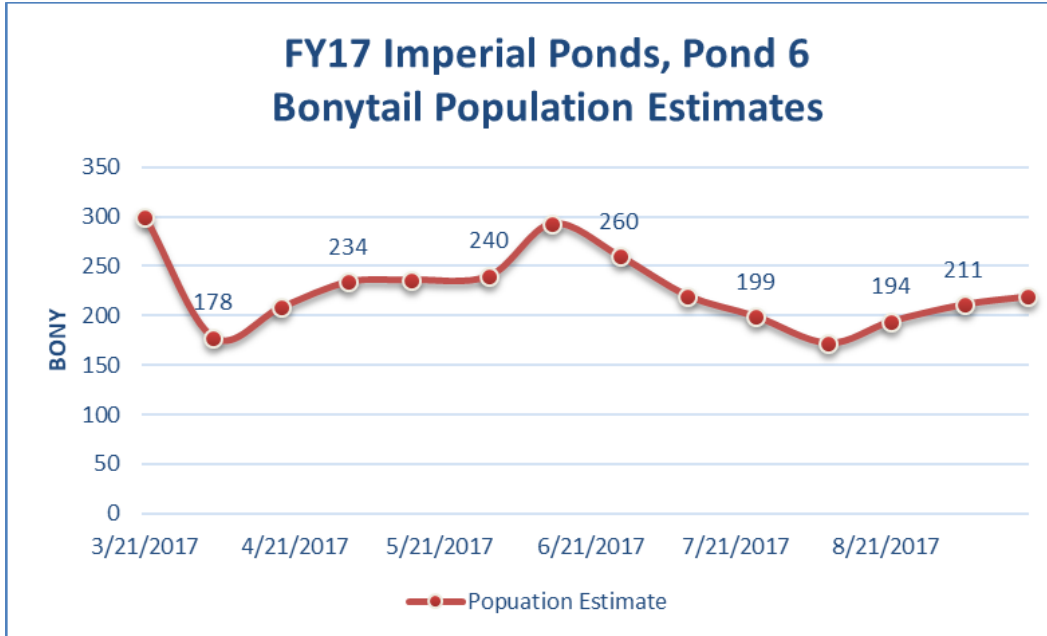


Figure 8.—Pond 6 bonytail population, FY17.

**Imperial Ponds Conservation Area
2017 Annual Report**

Larval fish surveys were conducted throughout each of the species' spawning periods using larval dip netting and larval light trapping techniques. Minnow traps were deployed post-spawning season to help detect evidence of spawning. Forty-eight larval light traps , 88 larval dip netting surveys, and 222 minnow traps were set in FY17 (table 4). Additional minnow traps were set in Pond 5 because of the presence of mosquitofish (*Gambusia affinis*).

Table 4.—FY17 Imperial Ponds monitoring effort

Method	Pond 1	Pond 2	Pond 3	Pond 4	Pond 5	Pond 6	Total
Larval light	14	2	14	14	2	2	48
Larval dip net	21	7	20	21	4	15	88
Minnow traps	2	15	2	2	190	11	222

All larval monitoring and minnow trapping resulted in the capture of 0 razorback suckers and 886 bonytail. All of the bonytail were captured from Pond 2, and evidence of a spawning event was obvious by early May. Young-of-year bonytail were abundant and readily observed throughout the pond and along the shorelines and boat ramp.

Table 5.—FY17 Imperial Ponds monitoring results

Method	Pond 1	Pond 2	Pond 3	Pond 4	Pond 5	Pond 6	Total
Larval light	0	0	0	0	0	0	0
Larval dip net	0	87	0	0	0	0	87
Minnow traps	0	799	0	0	0	0	799

4.1.2 Water Quality Monitoring

Physico-chemical water quality parameters, including temperature, dissolved oxygen (DO), specific conductivity, and pH, all have the potential to affect the survival of native fishes as well as their ability to complete their life cycle. Water quality in the Imperial ponds was monitored using multi-parameter water quality instruments that recorded temperature in degrees Celsius (°C), DO in milligrams per liter (mg/L), specific conductivity in microsiemens per centimeter (µS/cm), and pH. A single multi-parameter water quality instrument was deployed near the center of each pond, suspended at approximately 1 meter below the surface, and programmed to record data twice each day. The initial reading

is recorded within 1 hour before sunrise and the second reading 12 hours later (e.g., 5 a.m. and 5 p.m.). These times vary by season but are chosen to capture the lowest and highest temperature and DO readings of the day.

Water quality parameters within the ponds occasionally deviated from the threshold values suggested for native fishes by Kesner et al. (2008); temperature $< 33.3^{\circ}\text{C}$, DO $> 4.0\text{ mg/L}$, and pH < 9.0 ; however, no negative impacts to native fishes were documented during these periods. Temperature ranged from 10.9 to 38.9°C ; DO generally remained above 4.0 mg/L , with exceptions in Ponds 1 and 5 during the summer months; pH from 6.1 to 10.9 ; and specific conductivity from $1,454$ to $6,859\text{ }\mu\text{S/cm}$ (figures 9–12). No threshold value was suggested for specific conductivity. The suggested threshold water quality values are viewed as management guidelines to minimize environmental stressors on native fishes; they are not considered mortality thresholds. Both razorback suckers and bonytail have been observed surviving in habitats where water quality parameters exceed these suggested values.

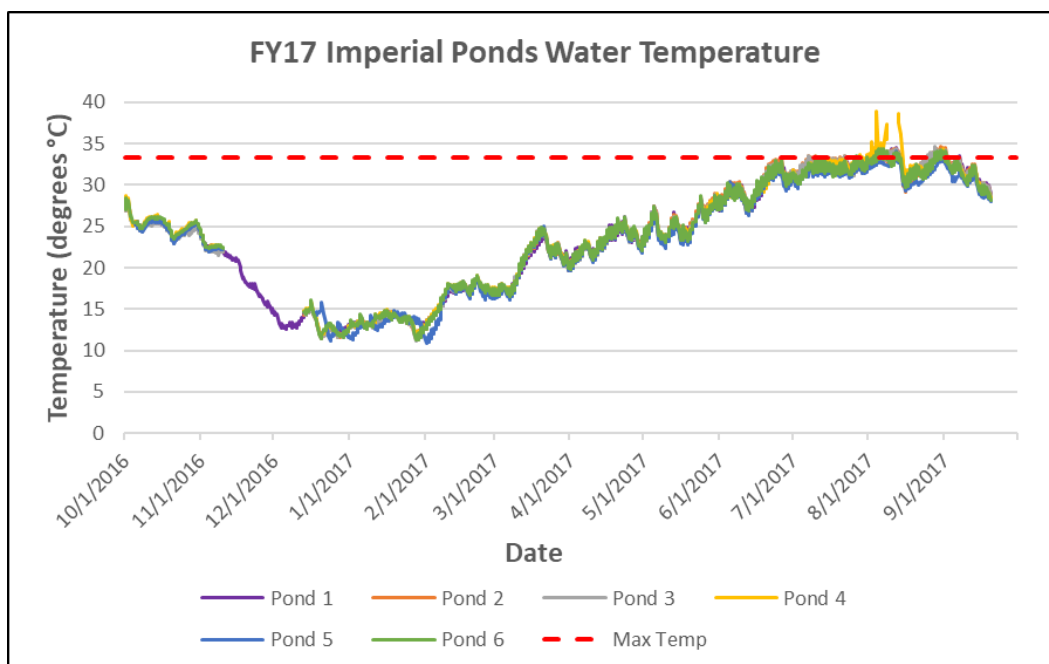


Figure 9.—Imperial Ponds 1–6 water temperature, FY17.

The dotted line represents a suggested threshold value for native fishes: $< 33.3^{\circ}\text{C}$.

**Imperial Ponds Conservation Area
2017 Annual Report**

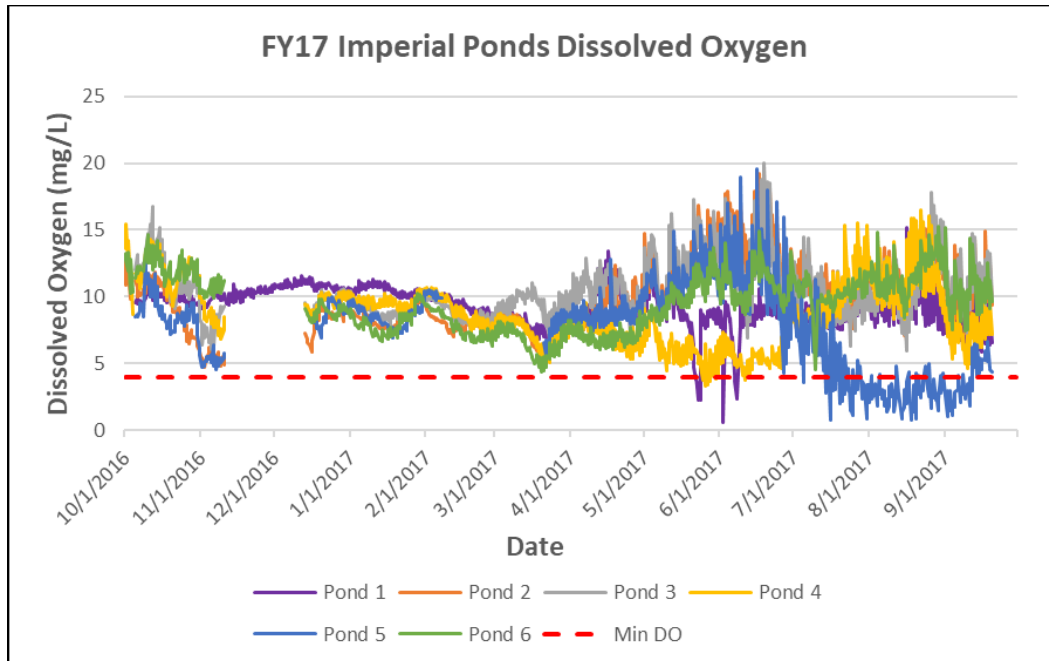


Figure 10.—Imperial Ponds 1–6 DO, FY17.
The dotted line represents a suggested threshold value for native fishes: > 4.0 mg/L.

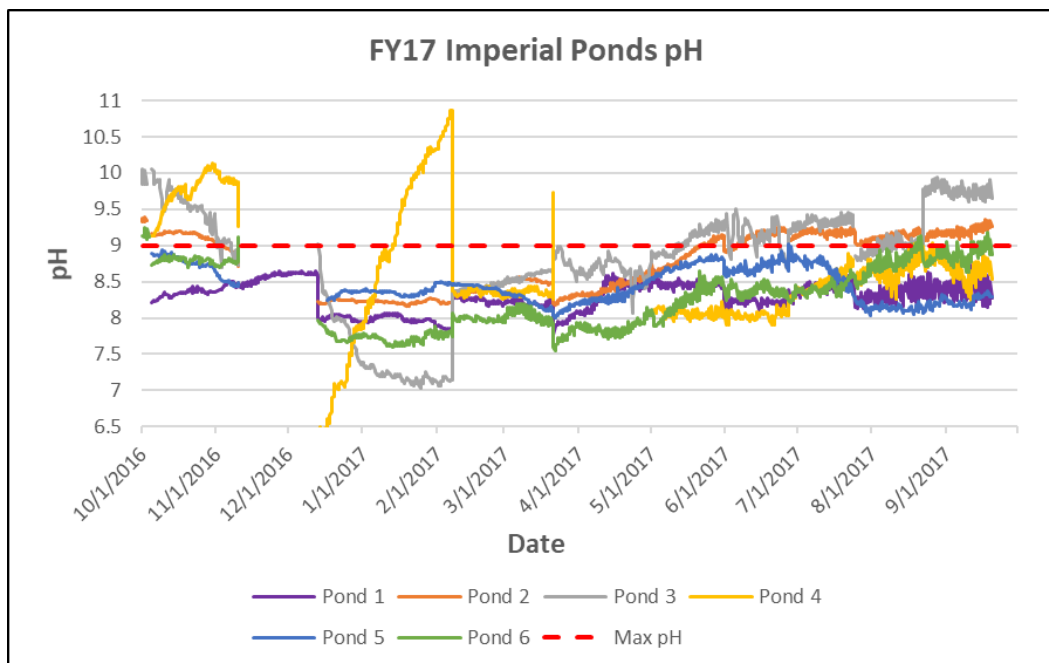


Figure 11.—Imperial Ponds 1–6 pH, FY17.
The dotted line represents a suggested threshold value for native fishes: < 9.0 mg/L.

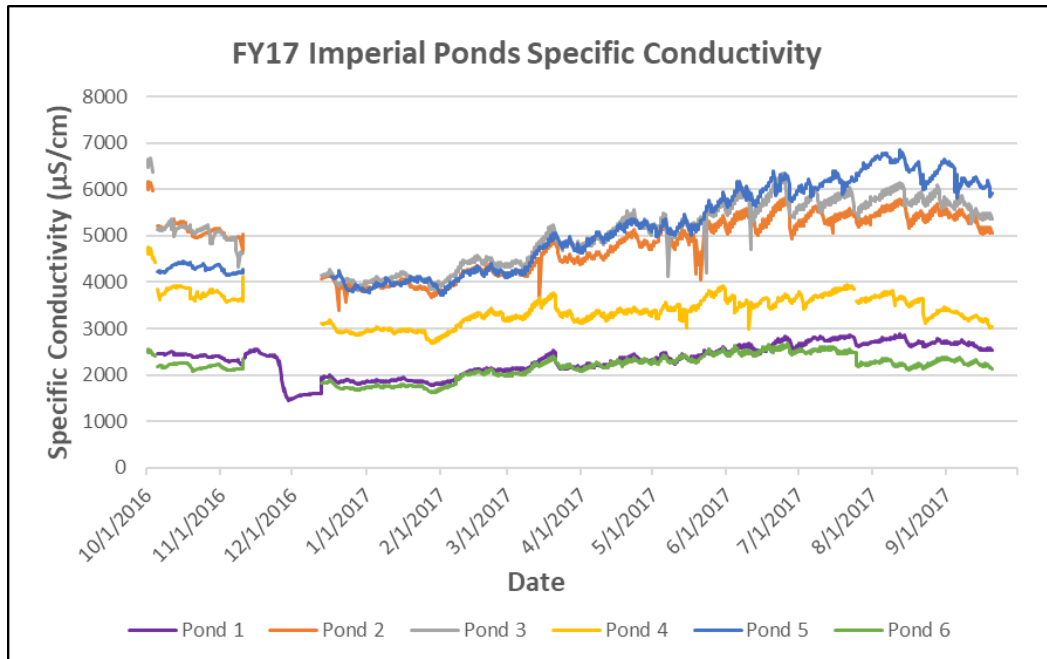


Figure 12.—Imperial Ponds 1–6 specific conductivity, FY17.

4.2 Avian Monitoring

4.2.1 Marsh Bird Surveys

Presence surveys for California black rails, western least bitterns, Virginia rails (*Rallus limicola*), and Yuma clapper rails were conducted in marsh habitat at the IPCA in three survey sessions during March and April. Three LCR MSCP marsh bird species were detected: California black rails, western least bitterns, and Yuma clapper rails. None were detected during the first survey session (March 17). One California black rail and two Yuma clapper rails were detected during the second survey session in Field 18 (April 7). Two Yuma clapper rails were detected in Field 18, and one western least bittern was detected at the ponds during the third survey session (April 21) (Ronning and Kahl, Jr. 2017).

5.0 HABITAT CREATION AND CONSERVATION MEASURE ACCOMPLISHMENT

5.1 Vegetation Monitoring

Vegetation data were collected in FY17 using light detection and ranging (lidar). Lidar measures the vegetation structure and provides the ability to identify structural diversity and successional growth stages. Conservation area vegetation will be evaluated on a periodic basis using lidar to ensure the habitat

is meeting species' requirements. A procedure to analyze and provide vegetation structure metrics will be developed, and the results will be presented in future reports.

Preliminary analyses suggest that airborne lidar may not provide the necessary detail for evaluating marsh habitat. Alternative techniques will be explored.

5.2 Evaluation of Conservation Area Habitat

The Final Habitat Creation Conservation Measure Accomplishment Tracking Process was finalized in October 2011 (LCR MSCP 2011). All areas within the IPCA were designed to benefit covered species at the landscape level.

The fish ponds will continue to be maintained consistent with the protocols employed during the water management study until a water delivery and management plan is developed. The water depths at Field 18 are managed during the breeding season for Yuma clapper rails, California black rails, and western least bitterns. Table 6 shows how much habitat is creditable for each of the targeted covered species at the IPCA. A total of three species with habitat creation goals have creditable acres at the IPCA. These species, including their corresponding conservation measure acronyms, are: Yuma clapper rail (CLRA1), California black rail (BLRA1), and western least bittern (LEBI1) (table 6).

Table 6.—Species-specific habitat creation conservation measure creditable total acres for 2017

Species-specific habitat creation conservation measure	BONY2	RASU2	CLRA1	BLRA1	LEBI1
Creditable acres in 2017	80 ¹	80 ¹	0	0	0
Total, including previous years	80	80	12	12	12

¹ Native fishes were stocked at the IPCA and are now deemed creditable in FY17.

6.0 ADAPTIVE MANAGEMENT

Adaptive management relies on the initial receipt of new information, the analysis of that information, and the incorporation of the new information into the design and/or direction of future project work (LCR MSCP 2007). Under the Adaptive Management Program, habitat creation sites will be assessed for biological effectiveness and whether they fulfill the conservation measures outlined in the HCP for 26 covered species and if they potentially benefit 5 evaluation species. Post-development monitoring and species research results will be used to

adaptively manage habitat creation sites after initial implementation. Once monitoring data are collected over a few years, and then analyzed for the IPCA, recommendations may be made through the adaptive management process for site improvements in the future.

There are no adaptive management recommendations for the IPCA at this time.

LITERATURE CITED

- Bureau of Reclamation (Reclamation). 2018. Colorado River Accounting and Water Use Report: Arizona, California, and Nevada, Calendar Year 2017. Bureau of Reclamation, Lower Colorado Region, Boulder City, Nevada.
- Kesner, B.K., M. Fell, G. Ley, P. Marsh. 2008. Imperial Ponds Native Fish Research Final Project Report, October 2007 – June 2008. Prepared for the Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada.
- Lower Colorado River Multi-Species Conservation Program. 2004. Lower Colorado River Multi-Species Conservation Program, Volume II: Habitat Conservation Plan, Final. December 17 (J&S 00450.00). Sacramento, California.
- _____. 2007. Final Science Strategy. Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada.
- _____. 2010. Lower Colorado River Multi-Species Conservation Program Fire Management & Law Enforcement Strategy. Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada.
- _____. 2011. Final Habitat Creation Conservation Measure Accomplishment Tracking Process. Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada. October 26.
- Ronning, C.J. and J. Kahl, Jr. 2017. Marsh Bird Surveys, Conservation Areas – 2017 Annual Report. Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada.